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THE EELS OF EASTER ISLAND
WITH A DESCRIPTION OF A NEW MORAY

By JOHN E. RANDALL and JOHN E. McCOSKER

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THE EELS OF EASTER ISLAND WITH A DESCRIPTION OF A NEW MORAY¹

By JOHN E. RANDALL² and JOHN E. McCOSKER³

ABSTRACT: Recent collections of fishes from Easter Island have yielded 11 eels in four families: one moringuid, *Moringua ferruginea* Bliss; two ophichthids *Schismorhynchus labialis* (Seale) and *Ichthyapus vulturis* (Weber and de Beaufort); one congrid *Conger cinereus* Rüppell; and seven muraenids, *Anarchias seychellensis* Smith, *Gymnothorax eurostus* (Abbott), *G. nasuta* De Buen, *G. porphyreus* (Guichenot), *G. panamensis* (Steindachner), *G. bathyphilus*, new species, and *Enchelycore ramosus* (Griffin). Only *G. eurostus*, *G. nasuta*, and *G. porphyreus* have been reported previously from the island.

Aemasia Jordan and Snyder and *Fimbrinares* Whitley are probable synonyms of *Enchelycore* Kaup. The following five specific synonymies are proposed: *Lycodontis umbra* Fowler 1944=*Gymnothorax panamensis* (Steindachner 1876); *G. obscurirostris* Rendahl 1921, *G. wieneri* Sauvage 1883, and probably *Muraena chilensis* Günther 1871=*G. porphyreus* (Guichenot 1848); *G. chalazius* Waite 1904 and *G. dentex* De Buen 1961=*G. eurostus* (Abbott 1860); *Fimbrinares mosaica* Whitley 1948=*Enchelycore ramosus* (Griffin 1926); *Caecula platyrhyncha* Gosline 1951=*Ichthyapus vulturis* (Weber and de Beaufort 1916).

Two morays have been confused under the taxon *Anarchias leucurus* (Snyder). The name *leucurus* applies to a species taken thus far only in the Hawaiian Islands. The other one is *A. seychellensis* Smith, of which we have seen specimens from the Hawaiian Islands, Johnston Island, Line Islands, Phoenix Islands, Samoa Islands, Marshall Islands, Marcus Island, and the type locality, Seychelles. This species has higher vertebral and dorsal fin-ray counts than *leucurus*. We provisionally identify our Easter Island specimens as *seychellensis* in spite of intermediate vertebral counts and a greater number of teeth than possessed by either *leucurus* or *seychellensis* from other localities.

Gymnothorax eurostus is recorded for the first time from Isla del Coco in the tropical eastern Pacific and from Marcus Island. In the Indo-Pacific region this moray has been taken only between latitudes 16 and 32 degrees.

G. panamensis is recorded from Isla San Felix (off Chile). A closely-related Indo-Pacific species, also brown with serrate teeth which has been identified previously as *G. moluccensis*, is now referred to *G. pindae* Smith. *G. moluccensis* is known only from the type specimen from Ambon. We record *pindae* for the first time from Tahiti, Johnston Island, Guam, Taiwan, Heron Island (Great Barrier Reef), Chagos Archipelago, Maldives, Seychelles, and Mauritius.

Comparisons are made of several Easter Island eels, mainly by vertebral counts, with populations of these species from other Pacific localities.

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INTRODUCTION

Until 1961 the total number of marine fishes recorded from Easter Island (also known by the Chilean name *Isla de Pascua* and the polynesian name *Rapanui*) was only 29, of which two were moray eels. Kendall and Radcliffe (1912) reported the first moray, *Gymnothorax dovii* (Günther). Regan (1913) doubted Kendall and Radcliffe's identification, indicating that their specimens were more likely *G. meleagris* Shaw. Rendahl (1921) recorded the second moray from Easter, describing it as a new species, *G. obscurirostris*. De Buen (1961), realizing that neither the names *dovii* nor *meleagris* properly applied to the moray listed by Kendall and Radcliffe, described it as a new species, *G. dentex*. He also described *G. nasuta* from three specimens and recorded three additional specimens of *G. obscurirostris*. In 1963 De Buen added new species and new records of fishes from Easter Island, bringing the total to 40 (although two are invalid). None of the new species or new records in this work, however, was an eel.

Three major collections in recent years have included eels not listed by De Buen or others. This paper constitutes a report on the eels of these collections.

The first was made in shallow water (surface to 5 m) at Anakena Cove by Ramsey Parks and crew of the yacht *Chiriqui* in October 1, 1958. Rotenone collecting equipment and instructions were provided by Wayne J. Baldwin, then of the University of California at Los Angeles. These fishes were first deposited in the collection at UCLA, but subsequently were transferred to the Natural History Museum of Los Angeles County (LACM) in 1960.

Extensive collections of fishes were made by Ian E. Efford, Jack A. Mathias, and associates during the Canadian Medical Expedition to the island in 1964-65. These were deposited at the University of British Columbia (BC). We have examined only specimens of uncertain identification from these collections.

The third series of collections was made by Randall, Gerald R. Allen, and Bruce A. Baker in January-February, 1969. The majority of these specimens have been deposited in the Bernice P. Bishop Museum (BPBM).

Other Indo-Pacific and eastern Pacific specimens were examined at or obtained from Scripps Institution of Oceanography (SIO), University of California at Los Angeles (UCLA), California Academy of Sciences (CAS) (including an Easter Island eel specimen from the 1934 Templeton Crocker expedition; and collections of Stanford University (CAS-SU)), University of Hawaii (UH), Field Museum of Natural History (FMNH), British Museum (Natural History) [BM (NH)], National Museum of Natural History, (USNM), Academy of Natural Sciences of Philadelphia (ANSP), Museum of Comparative Zoology, Harvard University (MCZ), Zoölogisch Museum, Amsterdam (ZMA), and Australian Museum, Sydney (AMS).

Diagnoses are based in part on specimens extralimital to Easter Island when there were insufficient individuals from the island. In determining the identity of Easter Island specimens, we examined eels from many localities. This has resulted in the need to clarify the classification of some species not occurring at Easter

Island. Partial synonymies are provided where applicable to Easter Island taxa or where new synonymies are proposed.

KEY TO EASTER ISLAND EELS

- 1a Head and trunk twice tail length; lower jaw projecting; pectoral fins minute, smaller than eye; depth 48 to 64 in total length *Moringua ferruginea* Bliss
- 1b Head and trunk nearly equal to tail; lower jaw included or nearly equal; pectoral fins, if present, larger than eye; depth 10 to 53 in total length 2
- 2a Posterior nostril in upper lip or within mouth; body whitish to tan with no prominent markings 3
- 2b Posterior nostril not associated with lip but in front of or above eye; body color variable, but if light colored, dark markings present 4
- 3a Dorsal and anal rays elevated and confluent; gill opening round, constricted on lower side *Schismorhynchus labialis* (Seale)
- 3b Body entirely finless; gill opening a slit, ventral in position
..... *Ichthyapus vulturis* Weber and de Beaufort)
- 4a Pectoral fins present; teeth small and in patches; margin of median fins black
..... *Conger cinereus* Rüppell
- 4b Pectoral fins absent; intermaxillary teeth and anterior mandibular teeth caniniform; margin of median fins not black 5
- 5a Dorsal fin origin more than a head length behind gill opening; posterior nostril above center of eye; an enlarged head pore just behind and median to each posterior nostril, enclosed in the same white area with the nostril *Anarchias seychellensis* Smith
- 5b Dorsal fin origin ahead of gill opening; posterior nostril ahead of center of eye and not closely associated with a head pore 6
- 6a Body light colored with dark brown interconnecting bands, forming a chainlike pattern; posterior nostril slitlike; jaws of adults hooked, closing only at tips
..... *Enchelycore ramosus* (Griffin)
- 6b Body without dark brown interconnecting bands; posterior nostril round; jaws closing completely or nearly so 7
- 7a Body plain brown, lacking dark or light markings; edges of mandibular and larger maxillary teeth finely serrate *Gymnothorax panamensis* (Steindachner)
- 7b Body spotted with dark or light; teeth smooth-edged 8
- 8a Anal fin with a prominent white margin; anterior nostril moderately long, the tip reaching beyond front of snout; teeth at side of maxillary uniserial 9
- 8b Anal fin without a white margin; anterior nostril not long; teeth at side of maxillary biserial, the inner row of 2 to 12 canines 10
- 9a Body dark brown with distinct small white spots anteriorly and irregular pale blotches posteriorly; only the anal fin with a continuous white margin; snout to anus 2.32 to 2.43 in total length *Gymnothorax nasuta* De Buen
- 9b Body pale with scattered dark brown blotches, most larger than eye; dorsal and anal fins with continuous white margins and dark submarginal zones; snout to anus about 2.2 in total length *Gymnothorax bathyphilus* new species.
- 10a Head relatively short, 8.2 to 10.5 in total length; anus near middle of body, snout to anus 1.95 to 2.20 in total length; depth of body 14 to 19 in total length; body light yellowish, densely spotted with dark brown; tip of tail not white
..... *Gymnothorax porphyreus* (Guichenot)

- 10b Head 6.9 to 8 in total length; tail longer than head and trunk, snout to anus 2.1 to 2.4 in total length; depth of body 10 to 15 in total length; body brown with numerous pale dots, and dark brown spots; tip of tail usually white *Gymnothorax eurostus* (Abbott)

MORINGUIDAE

Moringua ferruginea Bliss

Figure 1

Moringua ferruginea Bliss 1883, Trans. Soc. Roy. Arts Sci. Mauritius 13:57 (type locality, Mauritius).

DIAGNOSIS.—Body cylindrical and extremely elongate, the depth 45 to 70 in length; snout to anus two times tail length; pectoral fins very small; dorsal and anal fins confluent with small caudal fin; lower jaw projecting; anterior nostrils tubular, at front of snout; posterior nostrils with a slight rim, in front of eye; head length 12.5 to 17 in total length; vertebrae 115 to 132; life color of illustrated specimen pale pinkish shading posteriorly to light yellowish.

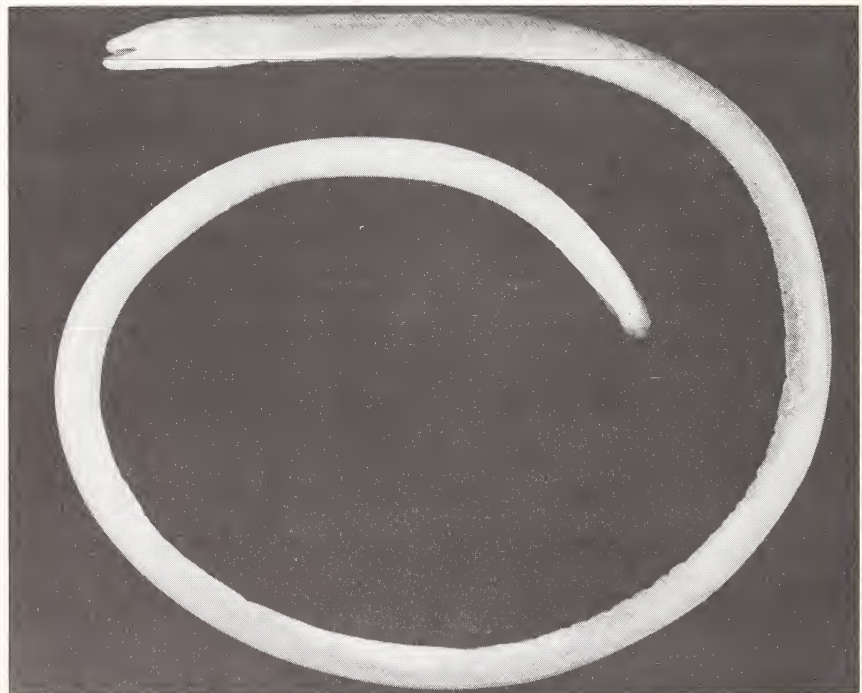


FIGURE 1. *Moringua ferruginea* Bliss, 295 mm, BPBM 6578.

REMARKS.—Gosline and Strasburg (1956) have shown that moringuids can vary remarkably with growth and sex. Conservatively, we regard the moringuids collected at Easter Island to be *Moringua ferruginea*, as delimited by Castle (1968): "head length contained 13-15 times in the total, depth 48-64 in total, and about 115-125 vertebrae." He gave the vertebral count of the holotype (MCZ 6156) as 125.

Castle regarded the species of *Moringua* from Hawaii as probably *ferruginea*. Gosline and Strasburg found that vertebral counts of 19 Hawaiian specimens ranged from 118-130 ($\bar{x}$ =125.1). Our Easter Island specimens have the head length contained 12.6-16.8 times in total length, the depth 45-70 in total length, and the number of vertebrae in 22 specimens ranging from 120-132 ($\bar{x}$ =129.0). This vertebral variation parallels the condition we found in *Ichthyapus* (see below) and is perhaps relatable to differing physical conditions and suggestive of population integrity within the Hawaiian and other Indo-Pacific island groups. Our Easter Island wormeels were taken from tidepools of less than 1 m to depths of 40 m. In all areas of capture the bottom was mainly rocky, but there were always at least some sandy pockets.

MATERIAL EXAMINED. (Throughout the material examined sections, the number of specimens with their total length in parentheses follows the designation of catalog reference number and institutional custody).—From Mauritius: MCZ 6156 (holotype), 1(255). From Easter Island: BPBM 6578, 1(295); 6579, 3(157-335); 6580, 1(158); 6581, 1(228); 6582, 1(325); 6583, 5(173-454). LACM 6560, 19(163-400). BC 65-455, 1(396); 65-457, 3(338-376); 65-461, 3(340-370). From Hawaiian Islands: SIO 68-531, 4(177-283).

OPHICHTHIDAE

Schismorhynchus labialis (Seale)

Figure 2

Muraenichthys labialis Seale 1917, Bull. Mus. Comp. Zool. 61:79 (type locality, Arno, Marshall Islands).

DIAGNOSIS.—Body nearly cylindrical, becoming laterally compressed on tail, and elongate, the depth 30 to 55 in total length; snout to anus 2.5 to 2.7 in total length; head length 10 to 13.2 in total length; pectoral fins absent; median fins elevated and confluent; dorsal fin origin less than a head length behind head; snout pointed and projecting; anterior nostril elongate and tubular; posterior nostril in upper lip under front of eye; gill opening small, round, on middle of lower side; body color whitish.

REMARKS.—Easter Island collections are represented by a single adult specimen taken in a rotenone station from between 1 to 5 m. This appears to be the easternmost record of the *Muraenichthys*-related echeline species (McCosker 1970).

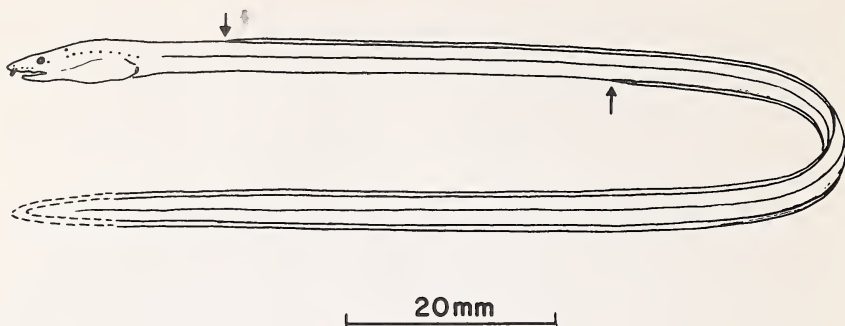


FIGURE 2. *Schismorhynchus labialis* (Seale), 165 mm, LACM 6560.

MATERIAL EXAMINED.—From Easter Island: LACM 6560, 1(165). From Hawaiian Islands: SIO 69-363, 1(125). From Palau Islands: CAS 24867, 39(101-137).

Ichthyapus vulturis (Weber and de Beaufort)

Figure 3, Table 1

Sphagebranchus vulturis Weber and de Beaufort 1916, Fishes of the Indo-Australian Archipelago 3:319 (type locality, Nasi besar Island, Sumatra).

Caecula (*Sphagebranchus*) *platyrhyncha* Gosline 1951, Pacific Sci. 5(4):312, figs. 14 b and d (type locality, Oahu, Hawaiian Islands).

DIAGNOSIS.—Body cylindrical and elongate, the depth 33 to 53 in total length; snout to anus 2.2 to 2.4 in total length; head length 11 to 12 in total length; no fins; tip of tail pointed and firm; snout pointed and projecting; anterior nostril on lower surface of snout, with a low broad rim; posterior nostril inside upper lip slightly anterior to eye; eye very small; gill opening a near-horizontal slit, ventral, and only about an eye diameter from opening of opposite side; Easter Island specimens light yellowish on back with a fine mottling of light brown; body abruptly whitish below lateral line; mottling darker on head, with small spots and irregular markings more evident.

REMARKS.—The Easter Island specimens of this snake eel collected by Randall and his associates were taken from moderately fine whitish sand at depths between 7.5 to 17.5 m. The specimens at LACM were collected in Anakena Cove at a depth not exceeding 5 m.

We follow McCosker (1973) in placing *S. vulturis* in *Ichthyapus*. Our examination of the holotype of *Ichthyapus vulturis*, and its comparison with Hawaiian, Palauan, and Tahitian specimens, has verified that it is a senior synonym of *C. platyrhyncha* Gosline. The characters of body depth, snout shape, and posterior nostril position that Gosline (1951: 313) used to separate the species were found not to differ.

The Easter Island population of this finless sandburrowing ophichthine appears to be homogeneous and it differs significantly from populations throughout

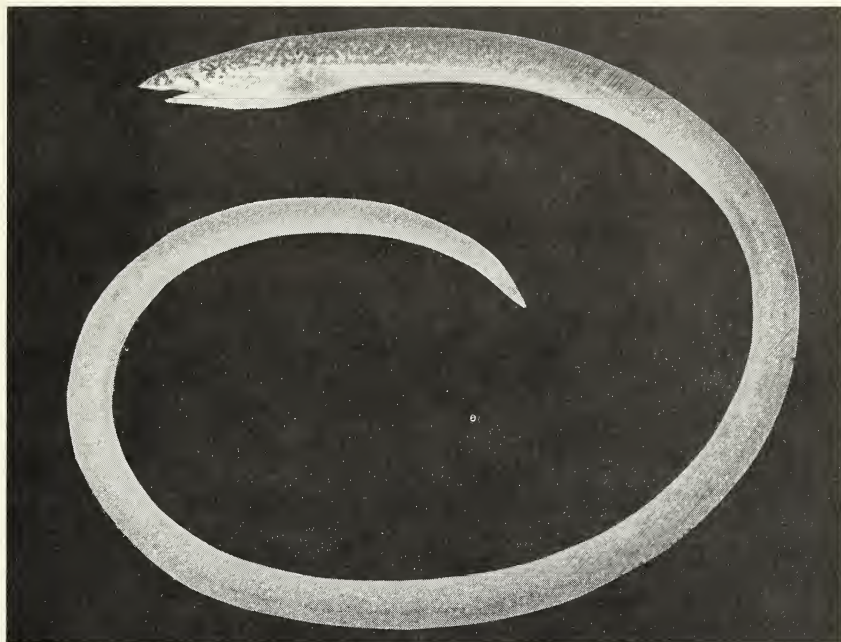


FIGURE 3. *Ichthyapus vulturis* (Weber and de Beaufort), 235 mm, BPBM 6589.

TABLE 1
Vertebral and preopercular pore counts of *Ichthyapus vulturis*
(Weber and de Beaufort).

Locality	Number of Specimens	Vertebrae		Preopercular Pores
		Range	Mean	Mean
Easter Island	9	130-134	132.3	3
Palau, Tahiti, and Seychelles	12	117-127	121.8	4
Hawaii and Kure	4	120-124	122.2	3.5
Sumatra	holotype		123	4

the Indo-Pacific (Table 1). This is evident from the higher vertebral counts and restricted variation as well as the absence of the fourth preopercular pore (present on all specimens from Palau, Tahiti, and the Seychelles which were examined). Hawaiian specimens appear intermediate in the pore condition. The closely-related eastern Pacific species, *I. selachops* (Jordan and Gilbert), is similar to the continuously distributed Indo-Pacific populations of *I. vulturis* in invariably having four preopercular pores (no variation in 22 specimens from eight localities

ranging from Panama to the Gulf of California). In spite of the differences in vertebral number and preopercular pore condition, we are hesitant to recognize the Easter Island population as distinct from *I. vulturis* until specimens from intermediate localities are examined.

MATERIAL EXAMINED.—From Sumatra: ZMA 104.153 (holotype), 1(240). From Easter Island: BPBM 6589, 1(235); 6590, 2(218-222); 6591, 1(246). LACM 6560, 5(281-402). From Hawaiian Islands: SIO 69-366, 3(175-446). BPBM 7907, 1(207); 7935, 1(169); 7939, 2(210-218). From Kure: SIO 68-487, 1(72.5). From Palau Islands: CAS 24866, 7(137-183). From Tahiti: SIO 69-270, 3(267-330). From Seychelles: SIO 63-150, 1(ca. 300).

CONGRIDAE

Conger cinereus Rüppell

Figure 4

Conger cinereus Rüppell 1828, Atlas Reise Nord. Africa. Fische rothen Meers 4:115, pl. 20, fig. 1 (type locality, Red Sea).



FIGURE 4. *Conger cinereus* Rüppell, 234 mm, BPBM 6585.

DIAGNOSIS.—Dorsal and anal fins well-developed, confluent with caudal fin; pectoral fins larger than eye, the rays 15 to 21; gill opening vertical, the upper end near middle of pectoral base; anterior nostril tubular, at tip of snout; posterior nostril in front and slightly above middle of eye; otic bulla absent; no canine teeth; vertebrae 139 to 152; lateral line pores anterior to a vertical at anus 37 to 42; body gray to brown with a broad black margin on median fins, a large black spot on pectorals (absent on small juveniles), and a black streak under eye.

REMARKS.—Specimens from Easter Island were collected from tidepool depths to 25 m.

Kanazawa (1958) divided *C. cinereus* into two subspecies, applying the name *marginatus* Valenciennes to those eels from Hawaii and *cinereus* to the other subspecies, which is broadly distributed throughout the Indo-Pacific. He believed that the number of vertebrae might prove of value for separating the two subspecies and afford them full specific status. He gave the range of numbers of vertebrae for *cinereus* as 139 to 146 and for *marginatus* as 148 to 152. Four of our Easter Island specimens, however, have a range of 145 to 149 vertebrae ($\bar{x}$ = 147.2). Preanal lateral line pore counts for the four specimens are 39 or 40 ($\bar{x}$ = 39.75). These favor Kanazawa's data for *marginatus*. On the other hand, the pectoral ray counts of 16 or 17 for Easter Island specimens (three counted, two with 17 rays) are best aligned with *cinereus*. We cannot, therefore, assign the Easter Island population of *Conger cinereus* to either subspecies.

MATERIAL EXAMINED.—From Easter Island: BPBM 6584, 2(103-118); 6585, 2(106-234); 6586, 1(92); 6587, 1(390); 6588, 5(270-430). LACM 6560, 5(132-645). From Hawaiian Island: SIO 68-531, 2(210-520). From Queensland, Australia: SIO 66-523, 1(282).

MURAENIDAE

Anarchias seychellensis Smith

Figure 5, Tables 2 and 3

Anarchias seychellensis Smith 1962 (in part), Rhodes Univ., Ichth. Bull. 23:428-429, pl. 53 F (type locality, Assumption Island, Seychelles).

DIAGNOSIS.—Depth of body 20 to 25 in total length; snout to anus 2.25 to 2.43 in total length; head length 8.1 to 9.6 in total length; snout 5.4 to 6.5 in head; eye 1.5 to 1.8 in snout; rayed portion of fins restricted to posterior end of tail; longest caudal ray 8 to 15 in head; posterior nostril above eye and enclosed in the same white area with an enlarged pore lying just behind and medial to it (rarely, a very narrow strip of pigmented tissue separates the nostril from the pore); two enlarged anterior lateral line pores above and in front of gill opening; teeth in jaws biserial, the outer row small, close-set, retrorse (except anteriorly), and nearly uniform in height, 26 to 32 on one side of upper jaw and 29 to 33 on one side of lower jaw; intermaxillary typically with three rows of three needlelike canines, the outer rows continuous with an inner posterior row of four or five well-spaced

canines on each side of maxillary; inner row of about seven canines on each side of anterior two-thirds of mandible; vomerine teeth conical, 7 or 8 in a single row. Body color varying from nearly uniform brown, through brown mottled with light brown, to brown with three or four rows of stellate pale blotches; fins at tip



FIGURE 5. *Anarchias seychellensis* Smith, 142 mm, BPBM 6563.

of tail whitish (yellow in life); ventral part of head pale, the lower jaw often mottled with brown; large pores on head white (those anteriorly may be narrowly edged in dark brown). Dorsal rays 42 to 51; vertebrae 115 to 117 (counts from three Easter Island specimens).

REMARKS.—This eel was collected from depths of less than a meter to 11 m, but was more common in the shallows, especially the larger rocky tidepools. Like other members of the genus *Anarchias*, it is a small species; our largest specimen measures 285 mm.

We first labelled our Easter Island specimens *A. leucurus*, since they agreed with those identified as *leucurus* from the Phoenix and Samoa Islands (Schultz 1943), Marshall Islands (Schultz et al. 1953); Johnston Island (Gosline 1955), and Hawaiian Islands (Gosline and Brock 1960). However, we changed our identification to *seychellensis* after examining the type of *leucurus* (USNM 50871), a 111 mm specimen taken in 28 fathoms between Maui and Lanai in the Hawaiian

Islands and described by Snyder (1904: 521, pl. 6, fig. 12) in the genus *Uropterygius*.

Anarchias leucurus has the posterior nostril closely allied with a large pore over the eye and the same body proportions as the Central Pacific specimens mentioned above; there is similarity in color (tip of tail and lower jaw pale), but a slight difference in body coloration led us to make a closer comparison. Instead of the color pattern of rows of irregular or stellate pale spots, a faint whitish reticulation may be seen on the upper part of the body of the holotype of *leucurus*. A radiograph of this specimen revealed 112 vertebrae and about 34 dorsal rays. Radiographs of 10 specimens of the other color pattern from the Hawaiian Islands and Johnston Island revealed 120 to 127 vertebrae ($\bar{x}$ = 124) and 41 to 49 dorsal rays ($\bar{x}$ = 45).

TABLE 2

Vertebral and dorsal-ray counts of *Anarchias leucurus* and *A. seychellensis*.

Species	Locality	Number of Specimens	Vertebrae		Dorsal Rays	
			Range	Mean	Range	Mean
<i>leucurus</i> ¹	Hawaii	8	112-118	114.2	33-38	36 ²
<i>seychellensis</i> ¹	Seychelles	2	118-121	119.5	42 ³	42 ³
<i>seychellensis</i>	Hawaii	7	122-127	124.7	41-49	45
<i>seychellensis</i>	Johnston Is.	3	120-124	123.3	43-48	45.3
<i>seychellensis</i>	Christmas Is. (Line Islands)	7	126-131	128.1	43-46	44.1
<i>seychellensis</i>	Easter Is.	3	115-117	116.0	42-51	46

¹Includes the holotype.

²Counts made of 5 of the 8 specimens, including holotype.

³No count of dorsal rays made on holotype.

Three recent rotenone collections of eels of the genus *Anarchias* from the Hawaiian Islands (BPBM 7937, 10071, and 10162), made at depths of 1 to nearly 30 meters yielded eight specimens that appear to be conspecific with *leucurus*. These have from 112 to 118 vertebrae and 33 to 38 dorsal rays.

The description of *Anarchias seychellensis* Smith seems to fit the specimens with high vertebral and dorsal ray counts, but no meristic data were given by Smith. Thomas F. Fraser, formerly of the J. L. B. Smith Institute of Ichthyology of Rhodes University (RUSI) provided a radiograph of the holotype of *seychellensis* (RUSI 317) and sent the two paratypes on loan. The radiograph reveals 121 vertebrae, but it is not clear enough to obtain an accurate count of the dorsal rays. The number of rays is certainly closer to the higher than the lower range of counts, however. One of the paratypes (RUSI 363, from Mahe) is aligned with the type, having 118 vertebrae and 42 dorsal rays.

The second paratype of *seychellensis* (RUSI 362, 110 mm, from Assumption) is neither *seychellensis* nor *leucurus*. It has 111 vertebrae, 28 dorsal rays, 32 teeth in the outer row on one side of upper jaw and 33 on the lower. The caudal fin is relatively long, about 9 in head; the nostril and enlarged pore with which it is paired are separated by a section of epidermis about as broad as the diameter of the nostril. The color is light brown with numerous small pale dots not arranged in rows (dots faint and not easily seen without the aid of a microscope).

The decision to identify our Easter Island specimens as *Anarchias seychellensis* has not been easy, and it should be regarded as provisional. The color and the number of dorsal rays strongly suggest *seychellensis*. The vertebral counts, however, lie intermediate to those of *leucurus* and the two valid types of *seychellensis*. The number of jaw teeth in the outer row is higher than those of specimens from any other locality investigated (Table 3). If the counts of the two smallest eels from the island (63 and 70 mm) were eliminated, the difference in the number of teeth of the remaining Easter specimens (30 to 32 upper teeth and 30 to 33

TABLE 3
Number of jaw teeth in the outer row on one side of
Anarchias leucurus and *A. seychellensis*.

Species	Locality	Number of Specimens	Upper Teeth		Lower Teeth	
			Range	Mean	Range	Mean
<i>leucurus</i> ¹	Hawaii	8	25-29	27.0	22-30	25.3
<i>seychellensis</i> ¹	Seychelles	2	22-25	23.5	24-26	25.0
<i>seychellensis</i>	Hawaii	7	24-28	24.6	25-27	26.1
<i>seychellensis</i>	Johnston Is.	4	24-26	25.2	23-28	24.7
<i>seychellensis</i>	Christmas Is. (Line Islands)	5	22-24	22.6	22-25	23.6
<i>seychellensis</i>	Easter Is.	6	26-32	29.3	29-33	30.5

¹Includes holotype

lower teeth) would be even more marked. Further study of comparative material of *Anarchias* from additional Indo-Pacific localities, particularly of islands nearer Easter Island such as the Tuamotu Archipelago, is needed to decide if the Easter Island population should be regarded as specifically distinct from *seychellensis*.

MATERIAL EXAMINED.—From Easter Island: BPBM 6563, 1(142); 6564, 6(114-285); 6568, 2(66-82); 6802, 1(95). LACM 6560, 56(64-198). BC 65-417, 1(115); 65-423, 1(114); 65-451, 1(185). From Hawaiian Islands: UH 2364, 6(176-210); 2979, 1(250). From Johnston Island: BPBM 9639, 3(135-162); 9640, 1(170). From Line Islands: UH 2714, 4(77-158); 2826, 7(73-174). BPBM 3615, 1(173). From Canton Island: BPBM

3613, 1(112). From Rongelap, Marshall Islands: USNM 141673, 9(123-168). From Marcus Island: BPBM 7024, 7(94-232).

Enchelycore ramosus (Griffin)

Figures 6-8

Gymnothorax ramosus Griffin 1926. Trans. Proc. N. Z. Inst. 56:539 (type locality, "Whangaroa and Bay of Islands, North Auckland districts," New Zealand, the locations of the holotype and paratype not differentiated).

Fimbrinares mosaica Whitley 1948. Rec. Austral. Mus. 22 (1): 72 (type locality, Point Banks, near Botany Bay, New South Wales); Whitley 1958. Proc. Roy. Zool. Soc. N. S. W. 30, fig. 4.

Gymnothorax sp. Randall 1970. Oceans 3(3):57, col. pl.

DIAGNOSIS (Easter Island specimens).—Depth of body 16.6 to 19.7 in total length (over the range of 181.5 to 508 mm); snout to anus about 2.5 in total length; head length 8.4 to 8.9 in total length; snout 4.2 to 5 head length; eye 8.5 to 11.9 in head length; upper jaw 2.07 to 2.22 in head length; jaws hooked, except in small specimens, closing only at tips, thus broadly exposing teeth; teeth in jaws biserial, the outer row of about 40 small teeth on each side of jaws, the inner row

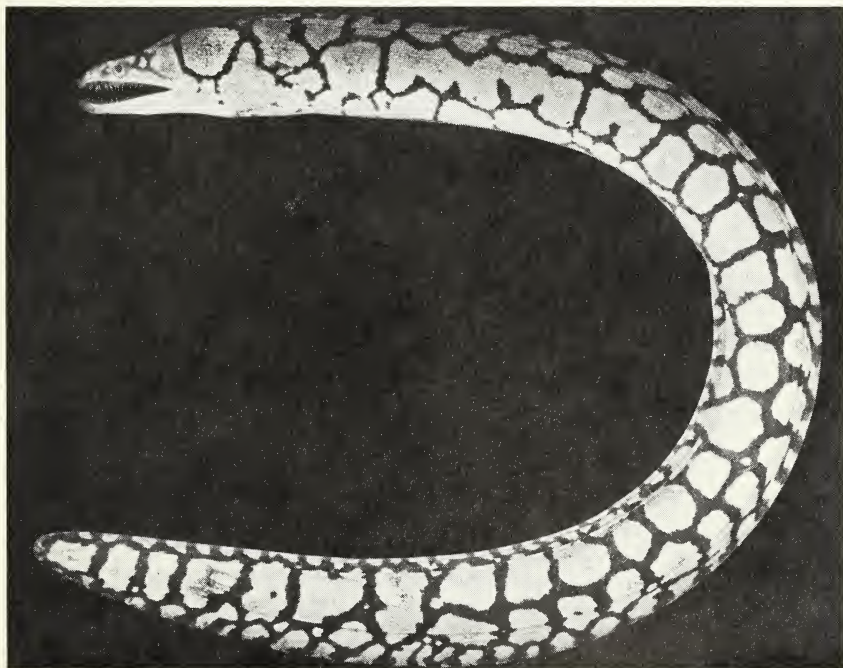


FIGURE 6. *Enchelycore ramosus* (Griffin), 508 mm, BPBM 6566.

of canines irregular; three rows of long canines on intermaxillary; two long canines in an inner row on each side at front of lower jaw; about eight small teeth in median row on vomer; posterior nostril elongate (nearly round in juveniles), its posterior edge above and in line with anterior margin of eye; posterior nostril nearly enclosed in a small white spot; body light tan with a faint flecking of light brown, this overlaid with a broadly anastomosing pattern of dark brown (this network encloses two series of large roundish to quadrangular spots of ground color, except posteriorly on tail where there is only one series).



FIGURE 7. *Enchelycore ramosus*, BPBM 6566, dentition.

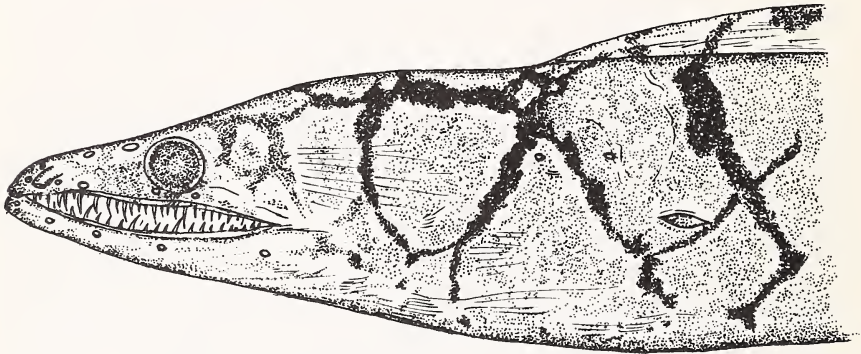


FIGURE 8. *Enchelycore ramosus*, BPBM 6566, head pores.

REMARKS.—*Fimbrinares mosaica* Whitley (1948) is herein placed in the synonymy of *Enchelycore ramosus*. Our comparison of the type of *mosaica* with specimens from Lord Howe and Easter islands has found them to be conspecific. The identification of Easter Island specimens as *E. ramosus* was determined by comparison of BPBM 6566 with specimens from Lord Howe Island and Australia. The Easter Island specimens represent a noteworthy range extension, not only in the 6000 miles (9650 km) separating the island from the Australian area, but also in the 7 degrees of latitude to the north. This moray, now known from New South Wales, New Zealand, and Lord Howe and Easter islands, might be expected from the islands of southern Oceania such as Norfolk and Rapa.

Differences exist between some of the measurements given by Whitley for the holotype of *mosaica* and the Easter Island specimens. In *mosaica*, body depth was given as 12 in total length, snout to anus distance as 2.1 in total length, head

length as 6.8 in total length, and eye diameter as 13.7 in head length. The posterior nostrils are rimmed with "conspicuous tassel-like superior fringes, formed by numerous laminae" (Whitley 1948). Some of these differences such as the stouter body, smaller eye, and the fringed nostrils probably reflect the much larger size of the Australian specimen. It is difficult to resolve all of these differences from size alone, however. There is also a difference in vertebral count. An X-ray of the holotype of *mosaica* provided by the Australian Museum revealed 145 vertebrae. Our four Easter Island specimens have 149 to 151 vertebrae.

The generic classification of the Muraenidae is in need of revision. Until such research is carried out, we cannot be certain of our placement of *ramosus* in the genus *Enchelycore*. The slender hooked jaws, elongate posterior nostril above and just in front of eye, origin of dorsal fin slightly in advance of gill opening, and some similarity in dentition all seem to ally this species with the West Indian *Enchelycore nigricans* (Bonnaterre), the type species of the genus. Rosenblatt (1967: 592, footnote) has placed the tropical Pacific *Gymnothorax bikiniensis* Schultz and *G. bayeri* Schultz and the eastern Pacific *G. octavianus* Myers and Wade in *Enchelycore*.

Based on external characters we provisionally assign the genera *Aemasia* Jordan and Snyder (1901) (type species, *A. lichenosa* Jordan and Snyder) and *Fimbrinares* Whitley (1948) (type species, *F. mosaica* Whitley) to the synonymy of *Enchelycore* Kaup.

The closest relative of *E. ramosus* would seem to be *E. lichenosa* (Jordan and Snyder) from Japan, a species in which pale areas are set off by a dark reticular pattern, forming approximately three rows of spots on the sides.

MATERIAL EXAMINED.—From Easter Island: BPBM 6566, 1(508). LACM 31184-1, 1(474). USNM 205156, 1(259). BC 65-440, 1(181.5). From New South Wales: AMS IA. 3926 (holotype of *F. mosaica*), 1(1033). From Lord Howe Island: AMS I. 9278, 1(855).

Gymnothorax panamensis (Steindachner)

Figure 9, Table 4

Muraena panamensis Steindachner 1876. Sitzb. Akad. Wiss. Wien 74:67-68 (type locality, Panamá).

Lycodontis umbra Fowler 1944. Monogr. Acad. Nat. Sci. Phila. 6:317, figs. 66-68 (type locality, James Bay, James Island, Galápagos Islands).

DIAGNOSIS.—Depth of body 16 to 23 in total length (over the range of 175 to 350 mm, the smaller eels more slender); snout to anus 2.2 to 2.4 in total length; head length 8.1 to 9.1 in total length; snout 5.3 to 5.8 in head; eye 1.75 to 1.9 in snout; edges of mandibular and the large anterior maxillary teeth finely serrate (serrations better developed on posterior edge); one or two prominent canines in single median row on intermaxillary; maxillary teeth in one row anteriorly, two along sides of jaws, the outer teeth at side of jaw small, about one-third to one-fourth as long as the slender canines of inner row; body uniform brown, the

margins of the fins a little paler posteriorly on some specimens, with a narrow dark brown ring around eye (broader posteriorly); two pores along side of upper jaw below eye each in a white spot, the more posterior spot much larger; posterior mandibular pores in small white spots.

REMARKS.—This moray appears to be the most common member of the genus in shallow water at Easter Island. It was not taken there at depths greater than 5 m.

In addition to our Easter Island material (on which the above diagnosis was based), we have examined specimens from Isla San Felix off Chile (previously unreported from this island), Isla Gorgona off Colombia, Pacific Panamá,



FIGURE 9. *Gymnothorax panamensis* (Steindachner), 366 mm, BPBM 6573.

Galápagos Islands, Isla del Coco off Costa Rica, Clipperton Island, Islas Tres Marias, Guadalupe Island, and throughout the Gulf of California. We could find no significant differences at the specific level among eels from these various localities. Some regional differences exist in body coloration (although generally

brown, the color may vary from light tan to grayish green); however, we believe these may be related in part to substratum conditions. Clipperton Island specimens, for example, match the light colored environment of this atoll.

Fowler's (1944) description of *Lycodontis umbra* clearly pertains to a young *Gymnothorax panamensis*. The identity of *L. umbra* was pointed out to us by R. H. Rosenblatt and verified by McCosker upon examining the type.

Interesting variation occurs in the number of vertebrae from the above mentioned eastern Pacific localities (Table 4). This pattern approximates a clinal situation.

TABLE 4
Vertebral counts for *Gymnothorax panamensis*.

Locality	Number of Specimens	Range	Mean
Isla San Felix, Chile	4	141-150	143.2
Easter Island	10	140-144	141.8
Galápagos Islands	7	134-139	136.3
Isla Gorgona, Colombia	3	126-128	127.4
Panamá (Pacific)	1		129
Clipperton Island	1		127
Isla Tres Marias	4	128-121	129.8
Cabo San Lucas	3	124-128	126.3
Gulf of California	5	123-126	125

We first identified our Easter Island specimens as *Gymnothorax moluccensis* (Bleeker), following Schultz in Schultz et al. (1953) whose five specimens from the Marshall Islands were described as uniform brown with teeth in a pattern similar to our material and bearing fine serrations. We compared our Easter Island eels with seven specimens in three lots from Tahiti (UH 2386, BPBM 7198 and 8102), one specimen from Guam (BPBM 6950), four from Johnston Island (BPBM 8955), two from Hawaii (UH 1710), and three from Midway (SIO 68-498). They range in total length from 120 to 380 mm and were taken in depths of 3 to 20 meters.

These morays are clearly distinct from the Easter Island specimens which we now identify as *panamensis*. They differ from *panamensis* in having a stouter body (depth 13 to 19 in total length over the range in length of 161 to 380 mm), longer head (head length 6.2 to 7.1 in total length), teeth in outer row on sides of upper jaw strongly slanted posteriorly, with only a few erect canines in a median row (may be entirely lost in adults). The teeth at this location in *panamensis* are

perpendicular in the jaws in both rows. There are also differences in color. Specimens from islands to the west of Easter Island lack white spots at pore sites on the sides of the jaws, the dark brown ring around the eye is narrower, and the body tends to be darker posteriorly with the fins even darker. Vertebrae for three Midway specimens ranged from 130 to 135.

Schultz (1953) appears to be in error in applying the name *Gymnothorax moluccensis* (Bleeker) to his specimens from the Marshall Islands, a name which was followed by Randall (1955) in recording this species from the Gilbert Islands, and Gosline and Brock (1960) in reporting it from Hawaii. The description and figure of *moluccensis* by Bleeker (1864, 4:198, pl. 187, fig. 1) and the re-examination of the type and only specimen (395 mm, from Ambon) by Weber and de Beaufort (1916) provide some differences for distinguishing it from the specimens from Oceania. Notable are the snout to anus distance (a head length longer than the tail for Bleeker's *moluccensis*; the tail is longer in the specimens from Oceania, the snout to anus being 2.27 to 2.4 in total length), a more slender body (depth of Bleeker's specimen 20 in total length), and a shorter head (head length of *moluccensis* 8.4 in total length).

Smith (1962:429-430, pl. 55D) described *Gymnothorax pindae* from a 335 mm specimen from Pinda, Mozambique, which is uniform drab brown and has serrate teeth. We can find no differences between his description and our specimens from Oceania; consequently we adopt his name for them. Subsequently, 17 additional specimens of *pindae* (126 to 386 mm total length) were found among recent unreported collections at the USNM and FMNH from Chagos Archipelago, Maldive Islands, Seychelles, Mauritius, Taiwan, and Heron Island on the Great Barrier Reef. Also two specimens, 287 and 290 mm in length, from Bikini Atoll in the Marshall Islands reported by Schultz in Schultz et al. (1953) as *Gymnothorax monochrous* proved to be *pindae*. Although formerly in the University of Washington collection, these are now catalogued at the USNM as 152956 and 152957, respectively.

MATERIAL EXAMINED.—From Easter Island: BPBM 6573, 4(322-366); 6574, 16(176-340). LACM 6560, 20(99-307). From Isla San Felix: SIO 65-624, 2(255-275); 65-626, 12(227-390); 65-628, 7(280-350); 65-629, 4(215-245). From Gulf of California: SIO 61-225, 3(60-107); 61-239, 11(114-216). From Islas Tres Marias: SIO 62-20, 27(72-200). From Isla del Coco: SIO 59-331, 2(36-63). From Clipperton Island: SIO 55-14, 1(230). From Pacific Panamá: SIO 67-34, 1(248). From Galápagos Islands: ANSP 70025 (holotype of *Lycodontis umbra*), 1(85). CAS-SU 37383; 37384; 37386. ANSP 117438. From Isla Gorgona: USNM 101794, 3(129-152).

Gymnothorax nasuta De Buen

Figure 10

Gymnothorax nasuta De Buen 1961, Montemar 1 (1): 5, and 10, fig. 3 (type locality, Easter Island).

DIAGNOSIS.—Body moderately elongate, the depth 14 to 17 in total length; snout to anus 2.32 to 2.43 in total length; anterior nostril projecting anterior to tip

of snout; teeth in jaws uniserial; a single median row of two or three long depressible canines on intermaxillary (although there may be two moderate canines anterior to this row, each slightly to one side); posterior nostril with a narrow low rim, the interior and edge white; moderate to dark brown with small white spots on head, anteriorly on body, on dorsal fin, and tip of tail (spots smallest anteriorly on head and toward margin on dorsal fin except where confluent in places along margin on posterior part of fin); rest of body and fins except margins with very irregular, dendritic, whitish to light brown blotches; anal fin with a promi-

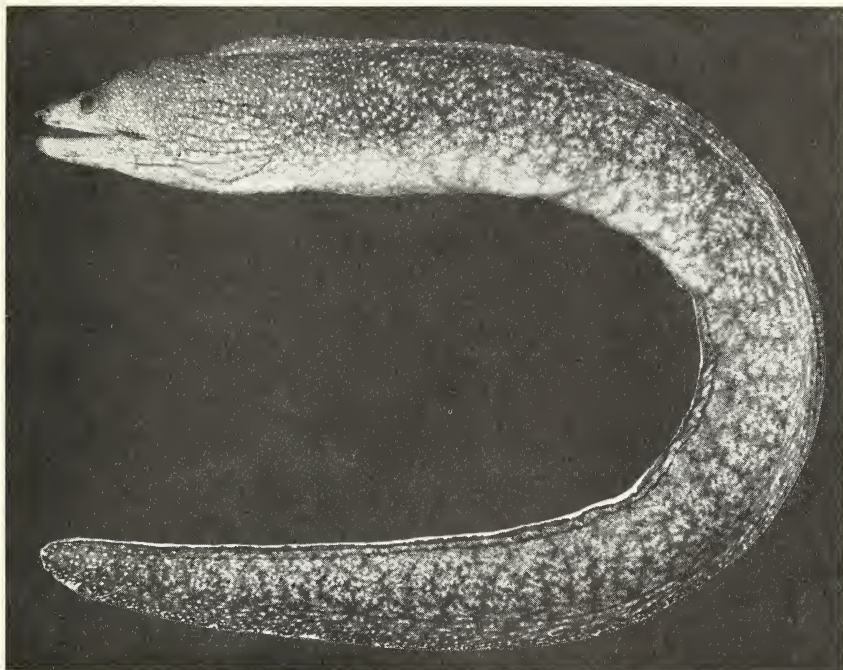


FIGURE 10. *Gymnothorax nasuta* De Buen, 712 mm, BPBM 6577.

nent white margin and a submarginal brown band; a dark brown blotch containing a few small pale spots in corner of mouth; branchial grooves dark brown.

REMARKS.—De Buen's description was based on three specimens, 510 to 670 mm total length, collected by Dr. P. Yáñez in November, 1947. We have two specimens, 595 and 712 mm in total length (BPBM 6577), which were collected by Randall and Bruce A. Baker on February 3, 1969 off Ahu Akapu on the west coast of Easter Island in 21 m. The bottom consisted of live coral and rock with a heavy cover of brown algae. Our 595 mm specimen is a ripe female and the larger a male. In life the small white spots were yellowish white, and the posterior nostrils were yellow.

***Gymnothorax bathyphilus* new species**

Figures 11-13

HOLOTYPE.—BPBM 6801, 728 mm, from the west coast of Easter Island off Mt. Tere Vaka in 250 meters. Collected with hook and line by Roberto Ika and G. R. Allen on February 13, 1969.

DESCRIPTION AND DIAGNOSIS.—Greatest depth of body 12.9 in total length; body width 2.2 in depth; tail longer than distance from snout to anus (snout to anus 2.18 in total length); head 7.6 in total length; trunk 3.06 in total length; dorsal fin origin ahead of gill opening, the predorsal distance 9.1 in total length; maximum dorsal fin height about 3 in maximum body depth; snout 4.8 in head; upper jaw length 2.26 in head; eye 12.8 in head, 2.57 in snout, a little closer to corner of mouth than tip of snout; fleshy interorbital width 8.6 in head; gill opening on mid-side of body, equal to eye diameter.



FIGURE 11. *Gymnothorax bathyphilus* new species, holotype, 728 mm, BPBM 6801.

Tubular anterior nostril long, projecting slightly ahead of snout, its length 1.6 in eye. Posterior nostril located on a vertical slightly in front of eye and short distance above a horizontal at upper edge of eye, the opening small, nearly circular, and lacking a rim.

Mouth closes completely, the lower jaw projecting slightly. Tiny papillae along edges of mouth visible under dissecting microscope. Teeth in jaws uniserial,

20 on one side of maxillary and 22 on the other, and 21 on one side of mandible and 23 on the other; longest maxillary teeth the fifth to seventh, their length nearly half diameter of eye; two maxillary teeth near front of jaw with a small sharp tooth at base on posterior edge; mandibular teeth slightly shorter than maxillary teeth; teeth smooth-edged, those at sides of jaws angling back sharply; several teeth toward the front of both sides with a poorly-developed basal cusp on the posterior edge (evident only by forcing soft tissue away from basal portion of teeth); two depressible canines in mid-line on intermaxillary, the more posterior one the longest, its length slightly more than half eye diameter. Three short conical teeth in a median row on vomer, beginning beneath center of eye.

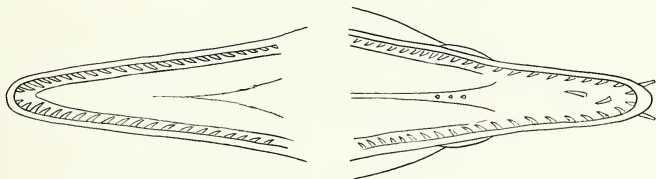


FIGURE 12. *Gymnothorax bathyphilus*, holotype, dentition.

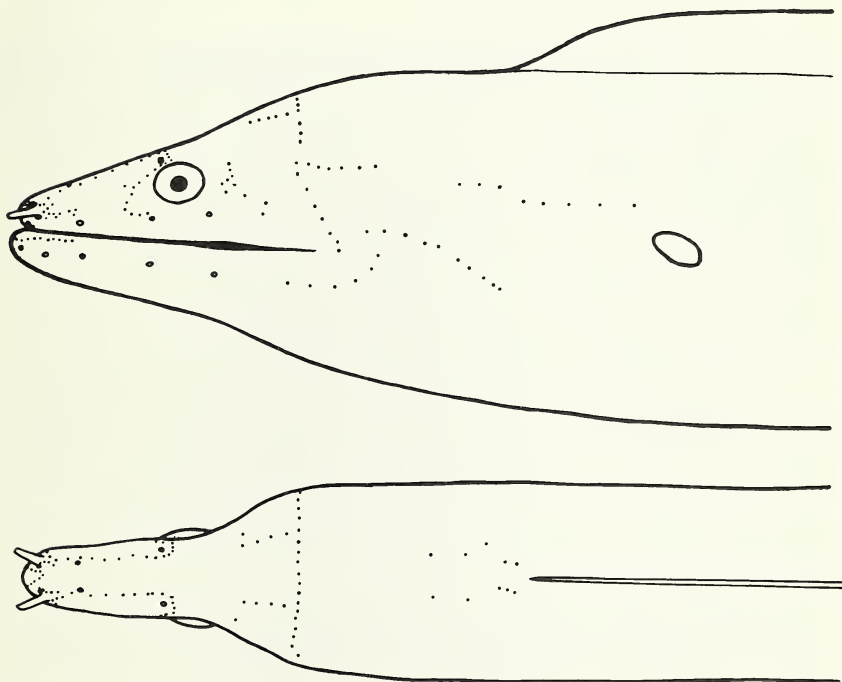


FIGURE 13. *Gymnothorax bathyphilus*, holotype, head pores.

Vertebrae 145.

Three large pores at front of snout forming a triangle enclosing base of anterior nostril; three more prominent pores along upper jaw, the first located half the distance from tip of snout to eye, the second below posterior nostril, and the third below lower edge of eye; a large pore nearly in line with anterior and posterior nostrils about one-third the distance from the anterior to the posterior nostrils. Six large pores along lower jaw (Fig. 13). Also present are tiny pores in series on the upper part of the head (Fig. 13), these pores visible without magnification because each is situated in a small blackish dot. Lateral line pores of body also in dark dots, thus permitting an approximate count of 135 posterior to gill opening.

Color in preservative light yellowish gray with a faint fine reticulum of light brown and scattered roundish dark brown blotches of variable size, mostly larger than eye; head anterior to corner of mouth without brown markings except for a dark brown line around eye and a small amount of dark pigment in the corner of the mouth; median fins with a prominent white margin and dark brown submarginal zone which is not sharply set off from the lighter color of the proximal remaining portion of the fins; gill opening not in a dark spot; nostrils colored like rest of snout; inside of mouth light yellowish; peritoneum pale. In life the color did not differ significantly from that in preservative.

ETYMOLOGY.—Named from the Greek *βαθύς* (deep), *φιλέω* (fond of), for its apparent preference for relatively deep water. A depth of capture of 250 meters is unusual for a moray eel.

REMARKS.—The closest relative of *G. bathyphilus* is *G. nubilus* (Richardson), the holotype for which is a 550 mm (21.5 inch) specimen from Norfolk Island. The body proportions and pattern of small pores on the head are similar for the two species, and both have white margins on the fins with dark submarginal stripe. The dentition of the two is different. For the lower jaw of *nubilus*, Richardson (1844) wrote: "Mandible armed by fifteen or sixteen teeth on each limb, the anterior ones taller, more remote, and having one or two minute, subulate ones in their intervals." He recorded 12 vomerine teeth. Our specimen of *bathyphilus*, though larger, has 21-23 mandibular teeth, and we can find no small interstitial teeth in the lower jaw. It has but three teeth on the vomer. The color is also different. *G. nubilus* is brownish, whitish on the belly, with cloudlike spots forming a series of irregular and in some cases confluent bars; there are black streaks on the throat, and the submarginal dark band in the fins is described as deep black.

In spite of the differences, we asked A. C. Wheeler of the British Museum (Natural History) to examine the type of *nubilus* (1972.1.26.159) for us. He confirmed the low tooth counts (12 plus 5 spaces on the left side of the mandible and 14 plus three spaces on the right; the upper jaw has 15 teeth on each side; there are 12 vomerine teeth) and the presence of small teeth at the bases of the three anterior teeth on the sides of both jaws. He was unable to make an accurate count

of the lateral line pores. A radiograph was provided which reveals 131 vertebrae, a significant difference from the 145 of *bathyphilus*.

Of the species of morays at Easter Island, *G. bathyphilus* is closest to *G. nasuta* De Buen, which has the same moderately long anterior nostrils and almost identical dentition. *G. nasuta* differs in coloration and in having a more elongate body (depth 14 to 17 in total length), a longer tail (snout to anus 2.32 to 2.43 in total length), a slightly larger eye (2 to 2.2 in snout), a low fleshy rim on the posterior nostril, and fewer vertebrae (138 or 139).

Gymnothorax porphyreus (Guichenot)

Figure 14

Murenophis porphyreus Guichenot, In: Gay 1848, Peces de Chile, In: Historia física y política de Chile, 2:342, pl. 11, fig. 2 (type locality, Chile).

?*Muraena chilensis* Günther 1871, Proc. Zool. Soc. London, 1871:674 (type locality, Chile).

Gymnothorax wieneri Sauvage 1883, Bull. Soc. Philom. Paris, ser. 7, 7:161 (type locality, Chile or Peru).

Gymnothorax obscurirostris Rendahl In: Skottsberg 1921, Nat. Hist. Juan Fernández and Easter Island, 61 and 62 (type locality, Easter Island).

DIAGNOSIS.—Depth of body 14 to 19 in total length; snout to anus 1.95 to 2.2 in total length; head length 8.2 to 10.5 in total length; snout relatively short, 4.3 to

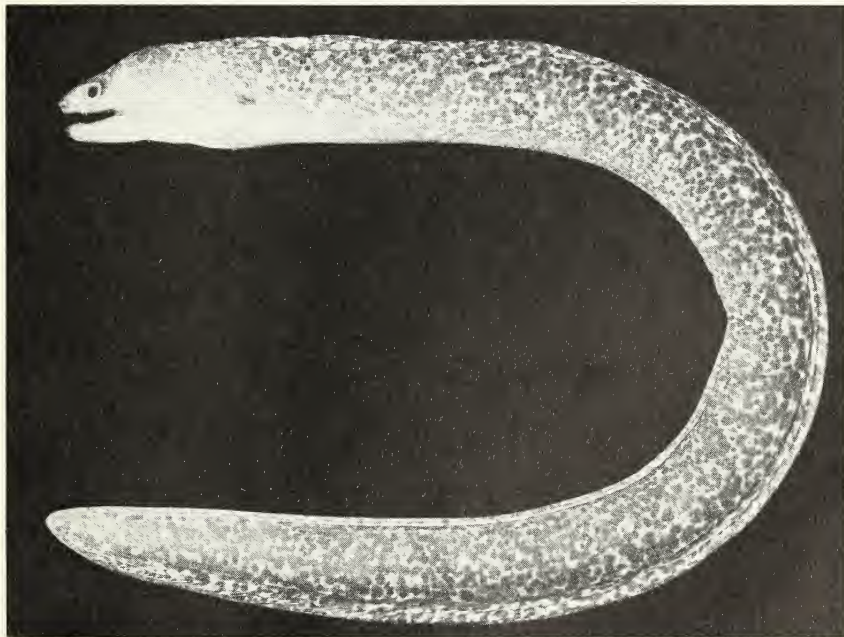


FIGURE 14. *Gymnothorax porphyreus* (Guichenot), 307 mm, BPBM 6575.

6.4 in head; eye small, 2.1 to 3.4 in snout, 10.2 to 17 in head; tubular anterior nostril short; posterior nostril with a low rim; maxillary with about 18 canines in the principal series, those at side of jaw small; an outer row of very small teeth anteriorly and an inner row of two to five longer teeth on side of jaw; usually three long depressible canines in a single median row on intermaxillary; mandibular teeth biserial anteriorly (the outer row of very small teeth), uniserial laterally; vomerine teeth uniserial but the row of teeth may bifurcate anteriorly; body light yellowish, so densely marked with medium to dark brown spots of about the size of the pupil that the overall color is primarily brown.

REMARKS.—Easter Island specimens were taken from tidepool depths to 13 m. This moray is less cryptic than other shallow water species at Easter Island and at times exhibited aggressive behavior.

Collections of fishes from Juan Fernández and San Felix have revealed *G. porphyreus* as a common member of the eel fauna of these islands as well.

Comparison of specimens from Easter, Juan Fernández, and San Felix islands with the brief description of *G. porphyreus* (Guichenot) (described from a drawing, the illustration seen by us), the detailed description of *G. wieneri* (Sauvage) from Peru by Hildebrand (1946), and specimens from Peru and Chile have convinced us that *wieneri* is a junior synonym of *porphyreus*.

We also consider *G. obscurirostris* Rendahl a synonym. The characters used by De Buen (1961) to separate this species from *porphyreus* appears to lie within the normal range of variation of *porphyreus*.

We consider *Muraena chilensis* Günther (1871) to be a probable synonym of *Gymnothorax porphyreus*. Randall has examined Günther's type specimen (material of Easter Island or Juan Fernández *G. porphyreus* was unavailable for direct comparisons) and made the following measurements: TL 868 mm, depth of body 12.7 in TL, snout to anus 1.87 in TL, head length 7.1 in TL, eye 19.7 in head. Alwynne C. Wheeler of the British Museum had kindly sent us a radiograph of the type, which has ca. 137 total vertebrae (the tail-tip is curled under in the radiograph), 60 of which lie before the anal fin. To our knowledge, *M. chilensis* has not been discussed in the literature subsequent to Günther's terse and non-illustrated description of the type. We regard *M. chilensis* as a junior synonym with slight reservations in that the type, a large individual, displays minor differences in morphometry from other *G. porphyreus*.

We have compared our material of *porphyreus* to two specimens from Lord Howe Island (CAS-SU 9218) and find no significant differences. The eye is slightly larger on the average and the snout to anus distance slightly smaller on the Lord Howe Island material. The total number of vertebrae is similar at each locality; four Easter Island specimens, 137-141 ($\bar{x}$ =139); five Juan Fernández and San Felix specimens, 138-142 ($\bar{x}$ =139.4); and the two Lord Howe specimens, 140 and 141. The preanal vertebrae from all these localities were 57-59.

In describing *obscurirostris*, Rendahl noted the similarity to *G. thyrsoideus* (Richardson 1844) from estuaries of the China Sea. He distinguished *obscurirostris* primarily by dentition, stating that *thyrsoideus* has biserial vomerine

teeth and comparatively fewer teeth. He might also have mentioned that the inner row of eight maxillary teeth (termed palatine by Richardson) is described as extending as far as the outer row. *G. porphyreus* has only two to five teeth at this location which do not approach the posterior end of the outer row of maxillary teeth. Other apparent differences seem evident from Richardson's (1844) remark regarding *thyrsoideus*: "Body high and considerably compressed with a deep dorsal . . ." *G. porphyreus* is not notably compressed, and its dorsal fin is not high (Günther 1870, however, described the fins of *thyrsoideus* as low). Richardson gives the snout to anus distance as 11 inches (28 cm) for the 26 inch (66 cm) type of *thyrsoideus*, indicating the tail is longer than that of *porphyreus*. Günther, who listed the type of *thyrsoideus* among the specimens in his Catalogue (vol 8), emphasized with italics that the skin has scale pouches. As pointed out by Rendahl, these are not apparent in *porphyreus*.

The moray identified as *thyrsoideus* by Seale (1906) from the Austral Islands, by Hiyama (1943) from the Marshall Islands, and by Schultz in Schultz et al. (1953) from the Marshall and Mariana Islands does not seem the same as the *thyrsoideus* of Richardson, and it is certainly not *porphyreus*. It appears to be related to *Gymnothorax griseus* (Lacépède) and may represent an undescribed species.

There are no confirmed records of *porphyreus* from a tropical locality. The known distribution of Chile, Peru, and the islands of San Felix, Juan Fernández, Easter, and Lord Howe involves areas where the sea is relatively cool.

MATERIAL EXAMINED.—From Easter Island: BPBM 6575, 1(307); 6576, 1(625). CAS 24762, 1[210, collected by the Templeton Crocker Expedition in 1934 and identified as *Gymnothorax undulata*? (Lacépède)]. LACM 6560, 4(430-540). From Isla Juan Fernández: SIO 65-645, 1(610). UCLA W66-52, 4(465-1090); W66-54, 9(275-390); W66-55, 3(330-415); W66-56, 3(52-410); W66-57, 7(325-535). USNM 176420, 2(606-745); 205151, 2(508-600). From Isla San Felix: SIO 65-628, 2(140-155). UCLA W66-50, 3(245-810). From Lord Howe Island: CAS-SU 9218, 2(417-449). From Peru: SIO 65-617, 1(715). USNM 77636, 1(403); 144193, 1(550). From Chile: USNM 176483, 1(552, but tail blunt).

Gymnothorax eurostus (Abbott)

Figure 15

Thyrsoidea eurosta Abbott 1861, Proc. Acad. Nat. Sci. Phila. (1860), 478-479 (type locality, Hawaiian Islands).

Gymnothorax chalazius Waite 1904, Rec. Austral. Mus. 5:139, 145-146, pl. 17, fig. 2 (type locality, Lord Howe Island).

Gymnothorax dentex De Buen 1961, Montemar 1:1, 5, and 12-14, fig. 4 (type locality, Easter Island).

DIAGNOSIS.—Depth of body 10 to 15 in total length; snout to anus 2.1 to 2.4 in total length; head length 6.9 to 8.2 in total length; snout 4.2 to 5.5 in head; maxillary teeth biserial, with about 35 small canines in the outer row on each side of jaw; the inner posterior row of about 10 to 12 longer canines; three rows of long canines on intermaxillary; mandibular teeth biserial anteriorly, the inner row of

moderately long canines; vomerine teeth uniserial; body color variable, but generally brown, becoming dark brown posteriorly, with numerous light yellow dots (more dense anteriorly); dark brown spots which may be as large or slightly larger than eye in approximate rows on body, becoming obscure anteriorly on tail; tip of tail white.

REMARKS.—Our Easter Island specimens were collected from less than a meter to 40 m. The species was taken at more localities around the island than any other moray. Three specimens ranging from 384 to 388 mm total length collected in late January, 1969, are ripe females.

Kendall and Radcliffe (1912) first recorded *G. eurostus* [as *G. dovii* (Günther)] from Easter Island. They had four specimens 380 to 650 mm in total length from Cook Bay, which were deposited in the Museum of Comparative Zoology at Harvard. Regan (1913) suggested from Kendall and Radcliffe's data that their specimens were more like *Gymnothorax meleagris* Shaw. Fowler (1928)



FIGURE 15. *Gymnothorax eurostus* (Abbott), 390 mm, BPBM 6571.

also erred in placing *eurostus* in the synonymy of *meleagris*. De Buen (1961) obtained two additional specimens (390 and 435 mm) from Easter Island which he described as a new species, *G. dentex*. We here relegate *dentex* to the synonymy of *eurostus*.

Among the specimens of *eurostus* at the Bishop Museum is one eel measuring 246 mm TL from Tubuai in the Austral Islands which Seale (1906) reported as *G. chalazius* Waite. This led us to analyze Waite's description of *chalazius*, based on two specimens, 320 and 415 mm, from Lord Howe Island. The description fits that of *eurostus* well, although the head is slightly shorter (8.3 in total length) than for specimens of *eurostus* available for comparison (HL 6.9 to 8.2 in TL).

Nine specimens, 77 to 462 mm, from Marcus Island (BPBM 7010, 7011, and 7785), collected by Randall in 1968, represent a new record for the species at that locality.

G. eurostus has an interesting distribution: Hawaiian Islands, where it is the most common inshore eel (Gosline and Brock 1960), Johnston Island (Gosline 1955), Easter Island, Austral Islands, Lord Howe Island, Heron Island on the Great Barrier Reef (Woodland and Slack-Smith 1963), Marcus Island, Taiwan (Chen and Weng 1967), Ryukyu Islands (Snyder 1912; Aoyagi 1943), Japan (Jordan, Tanaka and Snyder 1913), and Bazaruto Island, Mozambique (Smith 1962). The Heron Island, Taiwan, and Ryukyu Islands records were reported as *Gymnothorax meleagris* (Shaw and Nodder), and the Japanese and Mozambique records as *laysanus* (Steindachner). *G. eurostus* has also been listed from Japan as *meleagris*. A single 380 mm specimen of *eurostus* collected by Ramsey Parks and the crew of the "Chiriqui" at Isla del Coco, Costa Rica, represents the first record of this species from the eastern Pacific.

With the exception of Isla del Coco, all of these localities are peripheral in the Indo-Pacific between latitudes 16 and 32 degrees, N and S. The distribution of *eurostus* appears to be temperature-related. It is likely that this species transgressed the equatorial Indo-Pacific during a period when the seas were cooler. For a further discussion of relict fishes and peripheral distributions in the central and western Pacific, see Springer (1967).

Vertebral numbers of four Easter Island specimens (124 to 128, $\bar{x}$ = 125.8) are significantly higher (P = <.01 by t test) than those of eight specimens from the Hawaiian and Midway islands (115 to 121, $\bar{x}$ = 118.5). The holotype, examined by McCosker, has 119 vertebrae.

MATERIAL EXAMINED.—From Easter Island: MCZ 29663 (original number 3200), 1(380). BPBM 6567, 1(165); 6569, 3(132-383); 6570, 1(583); 6571, 2(390-395); 6572, 1(308). LACM 6560, 4(192-470). From Hawaiian Islands: ANSP 984 (holotype), 1(310). SIO 66-559, 2(295-395); 68-531, 3(245-440); BPBM 37, 1(175); 3578, 2(310-350); 5399, 2(225-242); 5801, 1(70); 8507, 1(340). From Leeward Hawaiian Islands: SIO 68-498, 3(190-530). BPBM 3580, 1(314); 3589, 2(400-450). From Johnston Island: BPBM 8937, 3(253-570). From Tubuai: BPBM 769, 1(246). From Marcus Island: BPBM 7010, 1(428); 7011, 4(185-462); 7785, 4(77-316). From Ishigaki, Ryukyu Islands: BPBM 8722, 3(197-269). From Isla del Coco: UCLA W58-378, 1(380). In addition, the USNM has 18 uncatalogued lots of *eurostus* from Taiwan and nine lots from One Tree Island and Heron Island, Great Barrier Reef collected by V. G. Springer and J. H. Choat.

DISCUSSION

Thirty-eight species of fishes are known in the literature from Easter Island. Recent collections which have provided the eels on which this paper is based will bring this total to about 109, including two sight records (Randall 1970). The collections made by Randall and his associates toward the end of a one-month stay on the island were almost devoid of species not taken previously, and, other than the two sight records just mentioned, no fishes were observed underwater which had not been collected. Certainly more species remain to be recorded, but 109 is probably not far from the definitive number for the island. Consequently it appears that Easter Island has an impoverished fish fauna. Marine invertebrates and algae are also represented by relatively few species. The island's extreme geographic and hydrographic isolation is undoubtedly the principal reason for the depauperate marine fauna and flora. Also its location at 27° S latitude puts it in a marginal position for both tropical and temperate forms. In 1963 the mean monthly sea surface temperatures varied from 19.2 to 26.1° C (maximum reading 28.1; minimum 15.7) (data courtesy of Centro Nacional de Datos Oceanográficos of Chile). As sea temperatures have varied cyclically with the ice ages (Hubbs 1948) there has probably been an alternate diminution of the species of warm water origin and those that came to Easter from cool environments. Still another reason for the paucity of species is the limited number of habitats. There are no estuaries or embayments, and no coral reefs. The bottom is predominately rocky, with relatively little sand.

Since a number of ichthyologists are still studying the fishes of these recent collections, it is too early to make an analysis of the ichthyofauna. It is apparent from preliminary results and papers already published, however, that the shore fishes of Easter Island owe their origin to three diverse areas: the tropical Indo-Pacific, the eastern Pacific, and the southwest Pacific. The tropical Indo-Pacific is the largest component of the Easter fauna. Six of the 11 Easter Island eels seem to be of Indo-Pacific origin, although *G. eurostus* is only marginally so (see account of this species).

It should be noted that none of the seven muraenids common to the Indo-west Pacific and the eastern Pacific (cf. Rosenblatt, McCosker and Rubinoff 1972) is known from Easter Island. This may be explained by the absence of suitable well-developed hermatypic reefs at Easter Island. The presence of *Gymnothorax eurostus*, as discussed above, at Isla del Coco is based on a single specimen and may represent a rare transport.

Two of the Easter Island eels are known only from the island at the present time: *Gymnothorax nasuta*⁴ and *G. bathyphilus*. The former has no recognized close relative in the Pacific that might provide clues to its provenance. *G. bathyphilus*, on the other hand, appears to be linked with *G. nubilus* from Norfolk Island.

Two other Easter Island morays may be derived from the southwest Pacific. *Enchelycore ramosus* is known from Easter, Lord Howe, New Zealand, and New

⁴Since the above was written, Randall collected a specimen of *G. nasuta* from 35 m at Pitcairn Island (BPBM 13265, 673 mm).

South Wales. *G. porphyreus* ranges from Chile and Peru to Lord Howe Island. Easter and Juan Fernández or Isla San Felix may have been stepping stones in the extension of its range into the eastern Pacific. Movement of larval forms from west to east at the latitude of Easter Island would not be possible with present day current patterns. During the ice age, however, Easter Island at 27° S would probably lie in the westerly belt, thus permitting such conveyance by current. Lord Howe and Norfolk islands seem too distant from Easter Island, however, to expect continuous passive transport of larval stages of fishes. It seems likely that such islands as Rapa and Pitcairn may have served as way stations. Almost nothing is known of the fish fauna of these islands.

A southern route, west to east across the south Pacific, has been suggested for several temperate fishes recently derived from the Australian and New Zealand faunas, including species of *Pterygotrigla* and *Cheilodanichthys* (Hubbs 1959) and *Muraenichthys* (McCosker 1970).

One Easter eel, *Gymnothorax panamensis*, seems to have originated in the eastern Pacific. It is broadly distributed from the Gulf of California in the north to Isla San Felix in the south. Easter Island represents its only known intrusion into Oceania.

Garth's (1973:329-331) distributional data for the brachyuran crabs of Easter Island provide an interesting parallel to Easter Island eel distribution. Of the 21 known Easter Island brachyurans, two are endemic, three are in common with the eastern Pacific, five range westward to Australia and northwestward to Japan, and the remainder range into the central Pacific and Indian oceans.

Eels constitute 10 per cent of the known fish fauna (species) of Easter Island. This is approximately the same percentage recorded from other well-collected island groups of Oceania. In the Hawaiian Islands (excluding Johnston Island and eliminating the deep water families and deep water congrids), eels represent about 12 per cent of the fish fauna reported by Gosline and Brock (1960). The same percentage applies to the fishes of the Marshall and Mariana Islands as listed by Schultz et al. (1953, 1960, 1966), if one adds 10 per cent to the fauna for the gobies which have not yet been reported and, in the light of papers by Gosline and Strasburg (1956) and Castle (1968), adjusts downward for the multiplicity of species of *Moringua*. In the Phoenix and Samoa islands eels comprise 11 per cent of the fishes reported by Schultz (1943).

The Muraenidae of Easter Island, with seven species, is more speciose than any family except the Labridae. That seven of the 11 eels known to the island are morays may seem unusual until one considers that almost the same ratio of muraenids to the total eel fauna exists at the archipelagos mentioned above.

Of 2145 fish species listed by Herre (1953) from the Philippines, about 90 are shallow water eels (again with an adjustment for *Moringua*). If we eliminate the cyprinids and catfishes from the total, the percentage of eels in the fish fauna is 3.8. The higher percentage of apodal fishes in islands of Oceania may reflect the protracted life attributed to the eel leptocephalus. A protracted larval stage in the pelagic realm is obviously an advantage in the colonization of oceanic islands. It should be pointed out, however, that relatively little collecting has been carried

out with ichthyocides in the Philippine Islands compared to the islands of Oceania discussed above. Undoubtedly the percentage of eels will rise when more such collections are made in the Philippines

Six of the Easter Island eels also occur in the Hawaiian Islands. Vertebral numbers of Easter and Hawaiian islands populations were compared for five of the six species. Since both Hawaii and Easter islands represent the most easterly and the most isolated outposts in Oceania in the northern and southern hemispheres, respectively, it is not surprising that the vertebral counts were significantly different ($P = < .01$ by t test) for four out of the five species: *Moringua ferruginea*, *Ichthyapus vulturis*, *Conger cinereus*, and *Gymnothorax eurostus*. In spite of these differences, we do not wish to recognize any of these eels by sub-specific designations. Far more study is needed before a meaningful system of nomenclature at the subspecific level can be proposed.

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